CLAIMS

1   1.   A method of assessing risks to pressure equipment associated with at least one

2   pressure relief system having a relief header, comprising:

3   a.   identifying one or more relief header inputs associated with the

4   equipment;

5   b.   identifying one or more common mode failure scenarios for the relief

6   header inputs;

7   c.   calculating a first hydraulic model for the one or more common mode

8   failure scenarios;

9   d.   defining a risk acceptance criteria for an accumulation in one or more

10   members of the equipment associated with the relief header inputs;

11   e.   defining initiating events frequency of occurrence for one or more

12   common mode failure scenarios;

13   f.   determining at least one of the risk acceptance criteria is not met by the

14   first hydraulic model;

15   g.   defining a probability of failure for one or more protection systems

16   associated with the equipment; and

17   h.   calculating an output by correlating an accumulation of the one or

18   more members of the equipment with the frequency of occurrence.

1   2.   The method of claim 1, further comprising comparing the output with the risk

2   of acceptance criteria.

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1   3.   The method of claim 2, further comprising adjusting the equipment, protective

2   systems, or a combination thereof to produce an output within the risk of acceptance

3   criteria.

1   4.   The method of claim 1, wherein calculating an output comprises:

2   a.   calculating a value for a number of possible permutations of relief

3   loads for the relief header inputs and common mode failure scenarios;

4   and

5   b.   determining whether to solve the possible relief loads based on the

6   value by sampling techniques.

1   5.   The method of claim 4, further comprising solving the possible relief loads by

2   sampling techniques, comprising:

3   a.   generating a random number for at least one of the relief header inputs;

4   b.   using the random number to categorize which protection system is

5   predicted to fail;

6   c.   calculating a variety of predicted relief loads for the relief header

7   inputs based on the categorization of the predicted failure; and

8   d.   repeating the generation of a random number and categorization for a

9   predetermined number of simulations.

1   6.   The method of claim 5, further comprising ranking the predicted relief loads

2   based on the equipment accumulation and analyzing the loads until a pre-determined

3   value of reliability is met.

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1 7.   The method of claim 6, wherein the value of reliability is statistically

2 determined.

1 8.   The method of claim 5, further comprising repeating the generation of the

2 random number and the categorization of the predicted failure for each relief header

3 input.

1 9.   The method of claim 1, wherein calculating the output by correlating the

2 equipment accumulation occurs for each relief header input.

1 10.   The method of claim 1, wherein calculating the output by correlating the

2 equipment accumulation occurs for one or more groups of relief header inputs.

1 11.   The method of claim 1, further comprising determining the probability of

2 failure for each type of protection system and calculating a probability of failure for

3 each relief header input having one or more of the protection systems.

1 12.   The method of claim 11, further comprising determining the frequency of

2 occurrence for a combination of protection systems associated with each relief header

3 input.

1 13.   The method of claim 1, further comprising identifying a plurality of common

2 mode failure scenarios and using the probability of failure for each protection system

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3   and the initiating event frequency for each common mode failure scenario to develop

4   an output of an equipment accumulation compared to the frequency of occurrence.

1   14.   The method of claim 13, further comprising comparing the output to

2   determine whether the risk acceptance criteria is within an acceptable predetermined

3   value for one or more specific members of the equipment associated with the pressure

4   relief system.

1   15.   The method of claim 13, further comprising combining the output of the

2   equipment accumulation compared to the frequency of occurrence for a plurality of

3   members of the equipment associated with the pressure relief system to determine an

4   overall risk for the equipment.

1   16.   The method of claim 14, further comprising determining the frequency of

2   occurrence for a combination of protection systems associated with each relief header

3   input.

1   17.   The method of claim 16, further comprising comparing the output to

2   determine whether the risk acceptance criteria is within an acceptable predetermined

3   value.

1   18.   A method of assessing risks to pressure equipment associated with at least one

2   pressure relief system having a relief header, comprising:

3   a.   identifying one or more relief header inputs associated with the

4   equipment;

5   b.   identifying at least one common mode failure scenario for the relief

6   header inputs;

7   c.   calculating a first hydraulic model for the at least one common mode

8   failure scenario;

9   d.   defining a risk acceptance criteria for an accumulation in the

10   equipment associated with the relief header inputs;

11   e.   defining initiating events frequency of occurrence for the at least one

12   common mode scenario;

13   f.   determining whether the risk acceptance criteria are met by the first

14   hydraulic model.

1   19.   The method of claim 18, further comprising determining that the risk

2 acceptance criteria are not met by the first hydraulic mode and further comprising:

3   a.   defining a probability of failure for one or more protection systems

4   associated with the equipment; and

5   b.   calculating an output by correlating an accumulation of one or more

6   members of the equipment with the frequency of occurrence.

1   20.   A system for assessing risks to pressure equipment associated with at least one

2 pressure relief system having a relief header, comprising:

3   a.   an electronic processor;

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4   b.   a memory coupled to the electronic processor, the memory containing

5   one or more programs to be processed by the electronic processor, the

6   one or more programs being adapted to:

7   i.   use input data for:

8   a.   identified relief header inputs;

9   b.   identified common mode failure scenarios for the relief

10   header inputs;

11   c.   defined risk acceptance criteria for an accumulation in

12   the equipment associated with the relief header inputs;

13   and

14   d.   defined initiating events frequency of occurrences for

15   the common mode scenarios;

16   e.   defined probability of failure for one or more protection

17   systems coupled to one or more of the relief header

18   inputs;

19   ii.   calculate a first hydraulic model for at least one of the common

20   mode failure scenarios;

21   iii.   automatically calculate probability of failures for combinations

22   of protection systems associated with the relief header inputs;

23   and

24   iv.   automatically correlate an accumulation of one or more

25   members of the equipment with the frequency of occurrences;

26   and

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27   c.   an output element coupled to the memory for producing an output of

28   the correlation of the accumulation of one or more members of the

29   equipment with the frequency of occurrences.

1   21.   The system of claim 20, wherein the one or more programs are further adapted

2   to automatically calculate a value for a number of possible permutations of relief.

3   loads for the relief header inputs and common mode failure scenarios for a group of

4   relief header inputs.

1   22.   The method of claim 21, wherein the one or more programs are further

2   adapted to:

3   a.   generate a random number for at least one of the relief header inputs;

4   b.   use the random number to categorize which protection system is

5   predicted to fail;

6   c.   calculate a variety of predicted relief loads for the relief header inputs

7   based on the categorization of the protected failure; and

8   d.   automatically repeat the generation of a random number and

9   categorization for a predetermined number of simulations.

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